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Human Grafting

The Brilliant and Successful Experiments of Dr. Serge Voronoff

By May Tevis

OUT of the monstrous evil of the war is it comforting to reflect that at least some good has come in an enormous stimulous given to medical science and surgical skill. Nowhere is this more marked than in the marvels of human grafting, which have performed actual miracles for countless wounded, crippled and disfigured men.

A well-known European surgeon, Dr. S. Voronoff, formerly a pupil under the famous Dr. Alexis Carrel of the Rockefeller Institute, and himself the author of the valuable work, a "Treatise Upon Human Grafting," contributes to a late number of *La Revue* (Paris), an article upon this vitally important subject. He says: "It is evidently not sufficient that the human grafting should exhibit good results for a limited time only; it is necessary that the result should be durable, and that the transplanted organ should give rise to no trouble in the new organism. On my return from New York in 1910, where I followed the work of Dr. Carrel, I undertook certain experiments in order to determine the conditions which might insure the definite vitality of grafted organs. I soon perceived that the organs borrowed by one animal from another of the same species sometimes exhibit signs of retrogression and atrophy. I concluded that the borrowed organ failed to find the proper vital conditions and nutritive environment in its new host necessary for its continued existence. Every living being represents a highly personal individual entity, possessing a peculiar temperament and blood character, which, while similar to that of other individuals of the same species, nevertheless has certain peculiarities which defferentiate the intimate biological conditions of the cell life in our organs. This indivdual difference varies in degree, and it occured to me that it must certainly be possible to find some individuals which were more closely similar than others among the same species. I based this opinion upon the fact that some individuals are found whose blood when mingled forms a uniform liquid wherein it is impossible to distinguish the portions coming from one or the other. There are others on the contrary whose blood immediately coagulates in contact with the added blood, and there are still others whose blood acts like an acid upon the blood which is poured into it, dissolving and destroying the red corpuscles. An organ borrowed from an individual whose blood is very different from that of the individual in which it is planted is naturally certain to die, since its nutritive environment is suddenly changed. On the other hand when the transplanted organ finds the same conditions which governed its previous life it continues to live in a normal manner. The success of the grafting depends therefore upon the affinity of the two creatures, upon the type so to speak to which they both belong. These ideas naturally led me to the conclusion that this affinity would be found especially among the members of the same family. In place therefore of selecting animals at chance, I undertook a series of experiments between related animals; these experiments were made at the Clinique Sainte-Marguerite, where I was assisted by Prof. Hobbs, Dr. Montalti and Dr. Rosanoff, and the Veterinary Surgeon, Buqueux. My first subjects were sheep, selected because shepherds are commonly very familiar with the relationship of the animals and their flocks. I had the immense satisfaction of finding my hypothesis confirmed by these experiments, and in 1912 I was able to present before the Congress of Surgery, held in Paris in 1912, transplanted organs exhibiting perfect vitality at the end of two years. In 1913 I was able to give a convincing demonstration of the truth of my theory by exhibiting at the International Congress of Medicine a lamb which has been conceived by a ewe, whose reproductive organs had been transplanted from her sister sheep after her own had been removed.

"Since the conditions of successive grafting even of complex organs has thus been demonstrated, the biological affinity should always be sought for, either in members of the same family, or in individuals not related, but in whom biologic affinity has been detected by the examination of the blood. It is obvious that success is still more certain when it is possible to take the graft from the individual itself since the transplanted organ then continues its existence without the change of previous conditions of life."

Having thus proved his theory by animal experimentation Dr. Voronoff proceeded to undertake human grafting. Shortly before the outbreak of the war he reported to the Academy of Medicine in Paris a remarkable case wherein he improved the condition of a child who was idiotic because of the atrophy of the thyroid gland by grafting upon it a thyroid gland of a monkey, and a still more remarkable case where he grafted a portion of a thyroid gland of a mother upon her son with remarkable results. The latter, a youth of twenty, resembled a child of ten in appearance, having been born without a thyroid gland. He had remained small, fat, with a neck sunken in his shoulders and the cretinoid face which recalls an animal. This boy, dull and apathetic, able to pronounce only a few intelligible words, and hiding in corners like a frightened animal, presented a painful contrast to his brother only a year older, but a big vigorous fellow fighting bravely at the front. In 1915 the mother, a strong and intelligent woman, gladly consented to have a portion of her own thyroid gland removed and grafted upon her son. The operation was highly successful, and at the end of a year an absolutely marvelous change was found in the afflicted youth. He had begun to grow, gaining sixteen centimeters (over 6 inches) in the year, his head was no longer sunken between his shoulders. The bloated look had disappeared; best of all his mind had been awakened. He was able to talk distinctly and he is at present earning his living by working in a bakery.

Dr. Voronoff says further: "These facts, together with many others of a less general character, such as the transplantation of foetal membranes, which I employed to restore the skin, and the facts published by Delbet, Tuffier, Walther, Vuttner, Lexer, etc., contributed to create favorable opinion toward the project of enabling our wounded men to profit by this new acquisition of science. In December, 1914, four months after the beginning of the war, the 'Service de Santé,' created at the Russian Hospital in Bordeaux, of which I was then in charge, a section of osseus grafting. The hospitals of the eighteenth Région were invited to send to this section all their wounded men suffering from lesions accompanied by loss of bone. Later in June, 1915, when the 'Service de Santé,' with the assistance of the generous philanthropist, N. de Spoturno-Coty, had created a hospital especially devoted to grafting, Auxiliary Hospital No. 197, and Paris hospitals were likewise invited to send there such wounded men as might be assisted by grafting. I therefore received a large number of men having wounds of this description, wounded men whom my colleagues had been wise enough not to subject to amputation even in cases where arms and legs were hanging like rags. In this new surgery there was still much investigation to be done as to the best instruments, process, operative conditions, etc. In times of peace the surgery of grafting was of too recent a date and its field was too narrow to have been fully systematized. The only subjects which had been conceived by a ewe, whose reproductive organs

those sufferings from tumors of the bones, and even in these cases the employment of grafting was very exceptional since the minds of surgeons were still imbued with the ancient ideas which inclined them to practice amputation whenever the continuity of the bone was interfered with for a considerable length. The first problem is to decide where to take the graft; as I have said, it is necessary that these grafts should find the same nutritive environment, and the same biological conditions in the new host, which they previously had. When the wounded man is able to bear it, the best thing therefore is to take the needed fragment of bone from his own body. At first the idea seems paradoxical, since the

FIG. 1. FRACTURE OF THE UPPER THIRD OF THE LEFT TIBIA (SHIN BONE) WITH A LOSS OF 4½ INCHES OF BONE

Entered hospital 40 days after receiving wound, his leg being immobilized in a plaster cast.

proposition is to repair a fractured leg or arm by breaking another bone of the wounded man. Happily the reality is less tragic than it seems. Nature has thoughtfully given us a bone which we can dispense with, without suffering any inconvenience. This is the fibula, that thin but solid bone which is able to bear a weight of 70 kilos (154 pounds) without breaking, and which is fastened to the tibia. Our body is supported by the femur which is joined directly to the tibia and not to the fibula, which we retain as a vestige of an ancestral condition, and which we can dispense with without trouble, at any rate without its upper part. Moreover, there are many animals which are excellent runners and yet do not possess this bone. When taken from the invalid himself this bone naturally finds the same vital conditions to which it is accustomed, and it is grafted with great ease in the new area to which it is tranplanted. Placed between parts of bones which are larger than itself, such as the femur or the tibia, it not only welds the broken parts together but it becomes larger itself, becoming indeed almost as large as the femur or tibia, thanks to the more abundant nutrition which it receives from the bigger blood vessels in its new position, and thanks also to the marvelous adaptability of every organ to its new function. This growth in volume naturally requires a certain length of time, sometimes a year or longer. But this bone is not the only one which can be used as material for grafting. The graft is often borrowed from the tibia, by cutting a piece of a certain thickness out of it, especially to repair an arm bone. The tibia is such a thick bone that it can stand such a loss without injuring its solidity; in fact, the wounded man who has had a piece of bone borrowed from his leg to mend his arm is able to get out of bed and walk without trouble ten days after the operation. In other cases I have borrowed a boney fragment to fill in a fractured bone from the longest fragment of the injured bone itself, and in my 'Treatise Upon Human Grafting,' in which I have described the development of grafts in various wounded men, there are radiographs and photographs of the patient to whom I applied this process with perfect results. I have found that the 'autograft,' that is a fragment of bone borrowed from the patient himself always gives excellent results in certain conditions. It is quite possible to graft bone taken from another individual or even from an animal, but under such conditions the result is less certain."

Dr. Voronoff even makes the startling statement that it is quite feasible to borrow bones from dead men to mend those of the living, since the death of the individual through the stopping of the heart and the cessation of the circulation of the blood does not cause the immediate cessation of life in all the organs. These continue to live for a certain length of time before decomposition sets in, the period varying with the delicacy of the structure. Dr. Voronoff states that bone survives for eighteen hours after the general death and when removed before this time has expired, it retains all the properties of the bone cut from the living individual, and may be used to repair fractures in the wounded man. He says:

"Bones of animals can likewise be employed, and some ten years ago I was able to transplant a piece of bone cut from the shoulder blade of a sheep under the influence of chloroform into the skull of the patient whose occipital bone had been partly destroyed by a tumor of the brain. After removal of the tumor the breach in the bone was filled in in this manner, and six months after the operation the skull was in perfect repair. In this case, however, I was able to prove that the sheep bone did not form a true graft upon the human bone, but that it was little by little dissolved and absorbed; but as fast as the cells of the sheep bone disappeared they were replaced by osseus cells coming from the human bones in the midst of which they had been implanted. The bone of the sheep, therefore, served merely as a scaffold which the human bones made use of in order to construct the now bone. It is possible, therefore, to make use of the bones of animals as a provisional living substance in order to form a sort of bridge between human bones, by means of which the cells of the latter may eventually join each other and become solidified."

It is very important, however, says the surgeon, that the tissues should be healthy in order to secure the success of

FIG. 2. X-RAY PICTURE OF FIG. 1 SHOWING LOSS OF BONE

the graft. Unfortunately, wounds received in battle are always infected, and while in this condition the transplanted fragment of bone will itself begin to suppurate, hence no attempt at grafting should be made until the wound is completely healed, and there is not the slightest particle of pus remaining. Even so the graft cannot be undertaken immediately since it has been proved that even the healed wound retains within its depths for several months thousands of latent microbes, which are capable of being revived and producing fresh suppuration if the old wound is opened too soon. Dr. Voronhoff states that his experience has shown that it is necessary to wait from eight to twelve months on an average after the wound has been healed before attempting the graft.

It is also very important that the transplanted bone should be placed within the breech without the help of any foreign body, such as metal plates, wires or hooks. This is done by cutting the transplanted piece longer than the breach to be filled and splicing its ends into the ends of the broken bone. By proceeding thus excellent results are obtained. Dr. Morestin, who specializes in wounds of the face, has obtained really remarkable results by the grafting of bone and cartilage taken from the ribs, thus rebuilding broken jaw bones, and replacing the bones of the nose and eye sockets, etc. Skin grafting is also frequently practiced among wounded men who have suffered the loss of large areas of skin. Without skin grafting many months would be required for the healing of such wounds, and the wound would then be covered with thin hard scar tissue lacking the flexibility and elasticity of the true skin. Moreover, said scar tissue often produces retraction of the limbs, giving them awkward and painful attitudes, or it may press upon the sensory or motor nerves in such a way as to cause inertia or interfere with the movement of the limb. Skin grafting on the contrary enables the surgeon to produce a smooth flexible perfect cutaneous covering in a comparatively short time. Dr. Voronoff has made use of skin grafting particularly for covering the stumps of legs which had been amputated in the ambulance. Such amputation is often done by the blow of an axe, leaving the stump quite uncovered by skin. In such cases after several months of suppuration the stump is covered by a thin and uneven layer of skin tissue, which is very senstitive and badly adapted to support an artificial limb. By means of skin grafting these large wounds can be completely covered with supple thick colorless skin in two weeks or less.

Dr. Voronoff states that he has not yet made a graft of a joint, although there are many cases where wounded men have had the joint entirely destroyed, and where the use of the limb might be saved by the transplanting of a joint from a recently deceased corpse. But since such an operation would be unusually delicate and difficult, it is necessary to experiment upon animals before attempting to practice upon human

FIG. 3. X-RAY PICTURE ONE MONTH LATER, SHOWING AUTOGENOUS GRAFT TAKEN FROM TIBIA OF THE RIGHT LEG

subjects. A very large number of such experiments were made by Dr. Voronoff during a period of a year at the Physiological Station of the Collége de France, and were described by him before the Bioligical Society of Paris. Dogs which had had a new foot joint grafted on were able to run, walk and jump six months later without anything to indicate that they had a new joint instead of the original one. On examination the articulations were found to be quite supple and well nourished by the blood vessels of new formation. The cartilage was flexible and movement perfect. "These happy results permit us to hope," says the surgeon, "that we might benefit our wounded men in similar manner. But none of these grafts, whether of bones, joints, skin, tendons or nerves, can be applied on a large scale until after the war, since, as I have stated, the wound must be entirely free from ancient septic centers. Moreover, these grafting operations should be undertaken only in hospitals into which patients with suppurating wounds are not received. Since the transplanted fragments have diminished vitally until they form the proper connection with the blood vessels of the new organism, the slightest infection will cause them to die."

While there are many thousands of men crippled by the war, this eminent surgeon holds out the glorious hope that

FIG. 4. RESULTS OBTAINED, SHOWING SCAR OF VORONOFF'S INCISION

a large majority of them may be restored to active life by such operations as he has here outlined. He says finally:

"During the war the most urgent cases only can be treated. Above all the lives of the wounded men must be saved; but after the war it will be our task to restore those men to health and usefulness. Ten years of continuous effort will be necessary to combat and modify the subsequent effects of wounds. Functional re-education and physiotherapy will certainly be of great service, but it will be grafting which will be most important of all. Bones will be grafted on to reconstruct jaws and eye sockets, and to make legs and arms serviceable; jaws will be grafted on to replace those which have been destroyed; skin will be grafted on to remove the disfiguration due to scars; tendons will be grafted to remedy contraction of the fingers; nerves will be grafted to cure paralysis of the limbs, and teeth and hair will be grafted to re-establish the harmony and beauty of the organism. Modern science can and must be bold enough to undertake this task. Humanity in its ascending evolution acquires new creative forces, and we shall become more and more the masters of our own bodies."

CURING SPANISH INFLUENZA WITH TURPENTINE.

The so-called Spanish influenza whose ravages have been general in America as well as in Europe, and which is said to have claimed more victims among our own troops than all the deadly missiles of the enemy, has naturally been a subject of much discussion among medical men the world over. As usual the doctors do not always agree. In a report read before the French Academy of Medicine, Dr. Bezançon made the statement that the pneumococcus is the microbe principally concerned. A fortnight later (August 27, 1918), Dr. Orticoni and Dr. Antoine declared before the same body that in a certain grave cases, at least, the present epidemic may be regarded as a new malady, characterized by the presence in the blood of a peculiarly resistant variety of Pfeiffer's bacillus. Since Dr. Orticoni is the director of the laboratory of epidemology in the French Army, and Dr. Antoine's office is that of consulting physician, they are probably correct as to the most fatal form of the disease. It is gratifying to learn that a new and simple form of treatment has been marvellously successful in curing the most severe and apparently hopeless cases. This treatment consists in the injection of